

## Patent Claims

1. Use of glass compositions with antimicrobial and/or disinfectant effect in materials for tooth restoration, excepting implants, in the field of fillings, wherein the filling is a material selected from the following group:

a composite material

a glasionomer cement

a compomer,

wherein the glass composition comprises the following components (in percentage by weight on an oxide basis)

SiO <sub>2</sub>	0 – 99.5 percent by weight
P <sub>2</sub> O <sub>5</sub>	0 – 80 percent by weight
SO <sub>3</sub>	0 – 40 percent by weight
B <sub>2</sub> O <sub>3</sub>	0 – 80 percent by weight
Al <sub>2</sub> O <sub>3</sub>	0 – 30 percent by weight
Li <sub>2</sub> O	0 – 30 percent by weight
Na <sub>2</sub> O	0 – 40 percent by weight
K <sub>2</sub> O	0 – 30 percent by weight
CaO	0 – 25 percent by weight
MgO	0 – 15 percent by weight
SrO	0 – 30 percent by weight
BaO	0 – 40 percent by weight
ZnO	0 – < 15 percent by weight
TiO <sub>2</sub>	0 – 10 percent by weight
ZrO <sub>2</sub>	0 – 15 percent by weight
CeO <sub>2</sub>	0 – 10 percent by weight
Ag <sub>2</sub> O	0.01 – 5 percent by weight
F	0 – 70 percent by weight
J	0 – 10 percent by weight
Fe <sub>2</sub> O <sub>3</sub>	0 – 5 percent by weight

and if necessary trace elements and/or normal refining agents in commodity quantities, wherein the sum of  $\text{SiO}_2 + \text{P}_2\text{O}_5 + \text{SO}_3 + \text{B}_2\text{O}_3 + \text{Al}_2\text{O}_3$  is greater than 20 percent by weight and a maximum of 99.5 percent by weight and the sum of  $\text{ZnO} + \text{Ag}_2\text{O} + \text{CuO} + \text{GeO}_2 + \text{TeO}_2 + \text{Cr}_2\text{O}_3 > 0.01$  percent by weight.

2. Use of glass compositions with antimicrobial and/or disinfectant effect in materials for tooth restoration, excepting implants, wherein the glass composition comprises the following components (in percentage by weight on an oxide basis):

$\text{SiO}_2$	0 – 99.5 percent by weight, preferably 0 – 80 percent by weight
$\text{P}_2\text{O}_5$	0 – 80 percent by weight
$\text{SO}_3$	0 – 40 percent by weight
$\text{B}_2\text{O}_3$	0 – 80 percent by weight
$\text{Al}_2\text{O}_3$	0 – 30 percent by weight
$\text{Li}_2\text{O}$	0 – 30 percent by weight
$\text{Na}_2\text{O}$	0 – 40 percent by weight
$\text{K}_2\text{O}$	0 – 30 percent by weight
$\text{CaO}$	0 – 25 percent by weight
$\text{MgO}$	0 – 15 percent by weight
$\text{SrO}$	0 – 30 percent by weight
$\text{BaO}$	0 – 40 percent by weight
$\text{ZnO}$	0 – < 15 percent by weight, preferably 5 - < 15 percent by weight
F	0 – 65 percent by weight
J	0 – 10 percent by weight
$\text{Fe}_2\text{O}_3$	0 – 5 percent by weight
$\text{Ag}_2\text{O}$	0.01 – 5 percent by weight

and if necessary trace elements and/or normal refining agents in commodity quantities, wherein the sum of  $\text{SiO}_2 + \text{P}_2\text{O}_5 + \text{SO}_3 + \text{B}_2\text{O}_3 + \text{Al}_2\text{O}_3$  is greater than 20 percent by weight and a maximum of 99.5 percent by weight, in particular a maximum of 80 percent by weight.

3. Application according to any one of Claims 1 or 2 in coating, filling or veneering materials for ceramic dental superstructures.
4. Application according to any one of Claims 1 through 3, characterized in that the glass composition comprises ZnO in the range of 0.25 to < 15 percent by weight, preferably 2.5 to 10 percent by weight.
5. Application according to any one of Claims 1 through 4, characterized in that the glass composition comprises Ag<sub>2</sub>O in the range of 0.05 to 2 percent by weight, in particular preferably 0.5 to 2 percent by weight.
6. Application according to any one of Claims 1 through 5, characterized in that the sum BaO + SrO is greater than 10 percent by weight.
7. Ion-releasing glass composition with antimicrobial effect for application as materials for tooth restoration, in particular in materials for fillings, in combination with materials for fillings, in particular selected from glasionomers, composites, compomers, wherein the glass composition comprises the following components (in percent by weight on an oxide basis):
 

P <sub>2</sub> O <sub>5</sub>	> 66 – 80 percent by weight
SO <sub>3</sub>	0 – 40 percent by weight
B <sub>2</sub> O <sub>3</sub>	0 – 1 percent by weight
Al <sub>2</sub> O <sub>3</sub>	> 6.2 – 10 percent by weight
SiO <sub>2</sub>	0 – 10 percent by weight
Li <sub>2</sub> O	0 – 25 percent by weight
Na <sub>2</sub> O	9 – 20 percent by weight
CaO	0 – 25 percent by weight
MgO	0 – 15 percent by weight

SrO	0 – 15 percent by weight
BaO	0 – 15 percent by weight
ZnO	0 – < 15 percent by weight
Ag <sub>2</sub> O	0 – 5 percent by weight
CuO	0 – 10 percent by weight
GeO <sub>2</sub>	0 – 10 percent by weight
TeO <sub>2</sub>	0 – 15 percent by weight
Cr <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
J	0 – 10 percent by weight
F	0 – 3 percent by weight

wherein the sum of ZnO + Ag<sub>2</sub>O + CuO + GeO<sub>2</sub> + TeO<sub>2</sub> + Cr<sub>2</sub>O<sub>3</sub> + J > 0.01 percent by weight.

8. Ion-releasing glass composition with antimicrobial effect for application as materials for tooth restoration, in particular in materials for fillings, in combination with materials for fillings, in particular selected from glasionomers, composites, compomers, wherein the glass composition comprises the following components (in percent by weight on an oxide basis):

P <sub>2</sub> O <sub>5</sub>	> 66 – 80 percent by weight
SO <sub>3</sub>	0 – 40 percent by weight
B <sub>2</sub> O <sub>3</sub>	0 – 1 percent by weight
Al <sub>2</sub> O <sub>3</sub>	0 – 3.9 percent by weight
SiO <sub>2</sub>	0 – 10 percent by weight
CaO	0 – 25 percent by weight
MgO	0 – 15 percent by weight
SrO	0 – 15 percent by weight
BaO	0 – 15 percent by weight
ZnO	0 – < 15 percent by weight
Ag <sub>2</sub> O	0 – 5 percent by weight
CuO	0 – 10 percent by weight

GeO <sub>2</sub>	0 – 10 percent by weight
TeO <sub>2</sub>	0 – 15 percent by weight
Cr <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
J	0 – 10 percent by weight
F	0 – 3 percent by weight

wherein the sum of ZnO + Ag<sub>2</sub>O + CuO + GeO<sub>2</sub> + TeO<sub>2</sub> + Cr<sub>2</sub>O<sub>3</sub> + J > 1 percent by weight.

9. Ion-releasing glass composition with antimicrobial effect for application as materials for tooth restoration, in particular in materials for fillings, in combination with materials for fillings, in particular selected from glasionomers, composites, compomers, wherein the glass composition comprises the following components (in percent by weight on an oxide basis):

P <sub>2</sub> O <sub>5</sub>	> 45 – 90 percent by weight
B <sub>2</sub> O <sub>3</sub>	0 – 60 percent by weight
SiO <sub>2</sub>	0 – 40 percent by weight
Al <sub>2</sub> O <sub>3</sub>	0 – 20 percent by weight
SO <sub>3</sub>	0 – 30 percent by weight
Li <sub>2</sub> O	0 – 0.1 percent by weight
Na <sub>2</sub> O	0 – 0.1 percent by weight
K <sub>2</sub> O	0 – 0.1 percent by weight
CaO	0 – 40 percent by weight
MgO	0 – 40 percent by weight
SrO	0 – 15 percent by weight
BaO	0 – 40 percent by weight
ZnO	0 – < 15 percent by weight
Ag <sub>2</sub> O	0 – 5 percent by weight
CuO	0 – 15 percent by weight
Cr <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
J	0 – 10 percent by weight

TeO <sub>2</sub>	0 – 10 percent by weight
GeO <sub>2</sub>	0 – 10 percent by weight
TiO <sub>2</sub>	0 – 10 percent by weight
ZrO <sub>2</sub>	0 – 10 percent by weight
La <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
Nb <sub>2</sub> O <sub>3</sub>	0 – 5 percent by weight
CeO <sub>2</sub>	0 – 5 percent by weight
Fe <sub>2</sub> O <sub>3</sub>	0 – 5 percent by weight
WO <sub>3</sub>	0 – 5 percent by weight
Bi <sub>2</sub> O <sub>3</sub>	0 – 5 percent by weight
MoO <sub>3</sub>	0 – 5 percent by weight

wherein the sum of ZnO + Ag<sub>2</sub>O + CuO + GeO<sub>2</sub> + TeO<sub>2</sub> + Cr<sub>2</sub>O<sub>3</sub> + J > 0.001 percent by weight.

10. Ion-releasing glass composition with antimicrobial effect for application as materials for tooth restoration, in particular in materials for fillings, in combination with materials for fillings, in particular selected from glasionomers, composites, compomers, wherein the glass composition comprises the following components (in percent by weight on an oxide basis):

SiO <sub>2</sub>	40 – 80 percent by weight
B <sub>2</sub> O <sub>3</sub>	5 – 40 percent by weight
Al <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
P <sub>2</sub> O <sub>5</sub>	0 – 30 percent by weight
Li <sub>2</sub> O	0 – 25 percent by weight
Na <sub>2</sub> O	0 – 25 percent by weight
K <sub>2</sub> O	0 – 25 percent by weight
CaO	0 – 25 percent by weight
MgO	0 – 15 percent by weight
SrO	0 – 15 percent by weight
BaO	0 – 15 percent by weight

ZnO	0 – < 15 percent by weight
Ag <sub>2</sub> O	0.01 – 5 percent by weight
CuO	0 – 10 percent by weight
GeO <sub>2</sub>	0 – 10 percent by weight
TeO <sub>2</sub>	0 – 15 percent by weight
Cr <sub>2</sub> O <sub>3</sub>	0 – 10 percent by weight
J	0 – 10 percent by weight
F	0 – 10 percent by weight

wherein the sum of ZnO + Ag<sub>2</sub>O + CuO + GeO<sub>2</sub> + TeO<sub>2</sub> + Cr<sub>2</sub>O<sub>3</sub> + J ranges between 5 and 70 percent by weight.

11. Glass composition according to any one of Claims 7 through 10, characterized in that the glass composition comprises ZnO in the range of 0.25 to < 15 percent by weight, preferably 2.5 to 10 percent by weight.
12. Glass composition according to any one of Claims 7 through 11, characterized in that the glass composition comprises Ag<sub>2</sub>O in the range of 0.05 to 2 percent by weight, preferably 0.5 to 2 percent by weight.
13. Glass composition according to any one of Claims 7 through 12, characterized in that the glass composition contains BaO and SrO and the sum of BaO + SrO is greater than 10 percent by weight.
14. Ion-releasing glass composition according to any one of Claims 7 through 13, characterized in that at least two vitreous phases are formed in the glass composition.
15. Ion-releasing glass composition according to Claim 14,

characterized in that in the glass composition at least two vitreous phases exhibit different compositions.

16. Ion-releasing glass composition according to any one of Claims 14 or 15, characterized in that the glass composition is a borosilicate glass composition.

17. Ion-releasing glass ceramic with antimicrobial effect for application as materials for tooth restoration, in particular in materials for fillings, in combination with materials for fillings, in particular selected from glasionomers, composites, compomers, wherein the base glass of the glass ceramic comprises the following components (in percent by weight on an oxide basis):

SiO <sub>2</sub>	20 – 90 percent by weight
CaO	0 – 45 percent by weight
Na <sub>2</sub> O	0 – 40 percent by weight
P <sub>2</sub> O <sub>5</sub>	0 – 15 percent by weight
Ag <sub>2</sub> O	0.01 – 5 percent by weight
ZnO	0 – 20 percent by weight

wherein the sum of ZnO + Ag<sub>2</sub>O + CuO + GeO<sub>2</sub> + TeO<sub>2</sub> + Cr<sub>2</sub>O<sub>3</sub> + J is greater than 0.001 percent by weight.

18. Ion-releasing glass ceramic according to Claim 17, characterized in that the crystalline main phases comprise alkali-alkaline earth -silicate and/or alkali-silicate and/or alkaline earth-silicate, excepting a glass ceramic with the sole crystalline main phase 1 Na<sub>2</sub>O · 2 CaO · 3 SiO<sub>2</sub> and the main phase Na<sub>4</sub>Ca<sub>3</sub>Si<sub>8</sub>O<sub>16</sub> (OH<sub>2</sub>).



19. Method for the production of an ion-releasing glass composition according to any one of Claims 14 through 16, characterized in that the at least two phases are preserved by means of tempering in a temperature range  $T_g \leq T \leq T_g + 300^\circ \text{C}$ , wherein  $T_g$  is the transformation temperature of the glass.
20. Method for the production of an ion-releasing glass composition according to any one of Claims 17 or 18, characterized in that the base glass for the glass ceramic is ground and subsequent to that a ceramizing of the powdery base glass takes place.
21. Method for the production of an ion-releasing glass composition according to any one of Claims 17 or 18, characterized in that the base glass for the glass ceramic is ceramized first and is ground subsequent to that.
22. Glasionomer cement for dental applications comprising:  
a polymer which contains free carboxylic acid groups,  
an ion-releasing glasionomer glass composition as well as  
an ion-releasing antimicrobial glass composition or an  
ion-releasing antimicrobial glass ceramic according to anyone of Claims 7 through 18.
23. Glasionomer cement according to Claim 22 characterized in that 1 – 90 percent by weight of the total composition is an ion-releasing glass/glass ceramic composition, wherein the ion-releasing glass composition comprises an ion-releasing antimicrobial glass or an ion-releasing glass ceramic

or is a mixture of ion-releasing glasionomer composition with an ion-releasing antimicrobial glass composition or an ion-releasing glass ceramic.

24. Glasionomer cement according to any one of Claims 22 or 23, characterized in that the  $\text{Ag}_2\text{O}$  content > 0.01 percent by weight.
25. Glasionomer cement according to any one of Claims 22 through 24, characterized in that the ratio of antimicrobial glass composition/glasionomer cement and/or fillings > 0.001.
26. Glasionomer cement according to any one of Claims 22 through 25, characterized in that the ratio of antimicrobial glass composition/glasionomer cement and/or fillings < 200, preferably less than 100, quite preferably less than 10.
27. Coating or veneering material for ceramic dental superstructures, comprising a base material, preferably a filling, in particular selected from:
  - a composite material,
  - a glasionomer cement,
  - a compomer,
  - an ion-releasing antimicrobial glass composition or an ion-releasing glass ceramic according to any one of Claims 7 through 18.